Improvement of
Bibliographic Compilation
Through Mechanization
as Applied to the
Current List of Medical Literature

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Council on Library Resources, Inc. - CLR-28

Interim Progress Report
for period ending December 31, 1958

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Under a two year grant of financial assistance from the Council on Library Resources, Inc., the National Library of Medicine is studying means of improving the services rendered by one of its major publications, the Current List of Medical Literature. This report will describe the progress achieved by the research project through 31 December 1958.

Background

The Current List of Medical Literature was introduced in 1941. It had the modest aim of providing a sort of order catalog for users of the Library's photoduplication services. It appeared weekly, and consisted of a listing of tables of contents arranged under broad subject categories. Some years later, monthly author and subject indexes were added.

In 1950, following the decision to discontinue publication of the Index-Catalogue, the old Current List was rehabilitated and began to appear monthly in a new format, consisting of three separate sections: register, subject, and author. The register section was a serially numbered listing of the tables of contents of journals, under journal titles in strict alphabetical array. The subject section consisted of main headings and

standard sub-headings, under which a third element (in National Library of Medicine jargon called the "modification") essentially a one-line annotation in lieu of title, served to pinpoint the content of a specific article and was keyed to the full citation by use of the serial number. The author section listed all authors' names, again using the serial numbering device to connect them with the full article citations appearing in the register section. After a brief experimental period, the Current List settled down into a pattern of semi-annual cumulations of the subject and author sections, which appeared as the June and December issues; this meant that only 10 regular issues were published each year.

Starting in 1950 with the total contents of about 1225 journal titles indexed, this had risen to more than 1600 by 1959. From these journals there came an annual indexing payload of some 105,000 to 110,000 items representing a broad cross section of the medical literature, well balanced from geographic, linguistic, and subject aspects. Shortly after the new Current List appeared, the practice of indexing technical reports of medical research projects was added. In terms of quantity of articles indexed, all this made the Current List of Medical Literature the largest indexing service of the literature of a specialized subject anywhere

in the world. The National Library of Medicine conducted a survey in 1957 to gather further information regarding the size and nature of the current medical periodical literature of the world. The findings of this project indicated that the total indexable medical periodical literature was in the neighborhood of 220,000 articles. These data showed that the Current List, despite its extensive coverage, was indexing about one half of the available material. Although the desirability of indexing all of the 110,000 items presently omitted is doubted, a good number - perhaps 70,000 additional articles - certainly merit inclusion in a general medical index.

Regarding the Current List's objective of achieving a satisfactory level of currency, the record was generally quite creditable. The monthly issues and the two semi-annual cumulations appeared regularly. The overall currency of the Current List was, however, adversely affected every six months. This was due to the periodic omission of a regular issue containing new material, which instead would back up in the files while the cumulation was being assembled. Over the next few months this publication backlog would eventually be dissipated, only to have the cycle repeat itself semi-annually. In addition, certain other characteristics of the production system had a deleterious effect on the currency picture.

Despite certain shortcomings, the tri-sectional arrangement of the Current List stood up quite well as a relatively simple and economical means of recording such a great mass of bibliographic data. Required by budgetary strictures to adhere to an annual limit on the number of pages used in printing the Current List, the Library found it essential that the format provide for maximum accessibility and coverage at a low cost in both page-space and dollars. By giving the journal abbreviation, volume, issue number, and date in the register just once for all the articles in a journal issue, and by using a mere number "address" under the entries in the subject and author indexes, considerable space was saved. In so doing, a third approach to the material, by journal title, was added to the traditional access by subject and author.

The shuttling back and forth from one section to another in order to find complete information irritated many users of the Current List accustomed to finding elsewhere a complete entry. More profound an objection to this format was the fact that the division of the entry among the three sections precluded its ready use for any other listing, short of reassembling the parts. Consequently even in the preparation of the "by-product" Bibliography of Medical Reviews a completely new recasting and composition of the

entries was necessitated. Finally, there were the overall page design and legibility of the three sections, conceived primarily from criteria of economy, that left something to be desired.

Production of the Current List involved the typing of register, subject, and author entries on individual 3x5 slips, the numbering of these slips, the arrangement of the slips in the respective sections, and the hand mounting of the individual slips by a shingling technique. The numbering system especially presented an inescapable bottleneck. The numerical addresses for each of the individual register, subject, and author entries had to be stamped manually in the exact location on the slip. This key operation could not, however, commence until all of the typed copy for a regular monthly issue had been gathered and arranged in the order of appearance of the articles in the register. Inasmuch as the numbers for the articles could not be known beforehand, this tedious operation could only be performed, in sequential order, by a single individual. By performing the mounting and numbering on a daily twenty-four hour basis, these operations could be telescoped into the few calendar days available in a given month and the deadline could be met.

Following preparation of printer's plates, each monthly issue was laboriously torn down, the thousands of slips were interfiled with those from preceding monthly issues, and then were reshingled, again by hand, for the six months' cumulation. It was an ingenious technique; but with each half-yearly volume including a

half-million slips, it approached its utmost limits and offered scant prospect for expansion or improvement.

Over the years, the Library searched for ways of overcoming these limitations. Following the establishment of the National Library of Medicine the search was intensified. By the end of 1957 a preliminary plan had been developed, and had received the enthusiastic approval of the Library's Board of Regents. The plan was submitted to the Council on Library Resources, which in April 1958 agreed to make the sum of $73,800 available to the Library over a period of two years for purposes of pursuing the project. This grant was officially accepted by the Department of Health, Education and Welfare in June.

The immediate objectives of the project are, first, to eliminate tedious composition methods through the introduction of mechanized techniques and thus to make possible the expansion of coverage and the improvement of currency; second, to improve convenience of use with a resultant wider acceptance of the index by its consumers. An auxiliary objective of the research project is to explore ways of expanding the services provided through the indexing program to permit multiple and derivative uses of the prepared material. Finally, it would be desirable to demonstrate the applicability of the system to scientific indexes generally, and

thus to assist in the relief of similar problems of literature processing in other subject fields.

There are, therefore, two phases to the research program: The publication system and the bibliographic retrieval system. Both systems are related and, to a degree, modify each other. The publication system involves a complex of procedures beginning with the acquisition and analysis of the printed materials and culminating with the emergence of a published index book. The bibliographic retrieval system consists of the coincident and subsequent exploitation of the file of references used in the publication system to produce listing of bibliographic citations along various subject lines. Both systems revolve around two main elements: a complete, self contained bibliographic citation which can be duplicated or manipulated at will (a unit entry) and, secondly, a high speed camera such as the "Listomatic" or "Foto-List" for the efficient, continuous listing of the entries to produce formal or informal bibliographic publications.

Publication System

The publication system comprises a complex of closely intertwined components such as format, form of entry, typography, mechanical composition, encoding and arrangement. These broader phases may be subdivided into more specific entities such as punched paper tapes, cards, typewriter platens and ratchets which often assume

an unexpected potency to modify radically the whole system. For purposes of this report, the attempt will be made to separate these elements and discuss them as much as possible individually; in practice, the entire system and its parts had to be studied in toto and simultaneously.

It is a truism that a system is merely a means to the achievement of an end; in this instance the objective is the publication of a large medical periodical index. The index proper, for which the project is exploring more efficient methods of compilation, will be characterized by professional, bibliographic and physical specifications which have been determined, on the basis of logic, experience, resources and needs, as the optimum.

Frequency and Coverage. The frequency of the index would remain a monthly. For the user this appears to provide a satisfactory compromise interval between issues; for the compiler it represents a reasonable length of time for the preparation of the manuscript. The deficiencies inherent in the present pattern of the Current List previously noted, would be eliminated by the publication of twelve monthly issues, all containing new material, rather than ten issues as at present. The cumulation would be a separate, annual publication, possibly offered to the subscribers as a separate service. By changing the cumulation period from six months to the entire year, literature searches conducted by

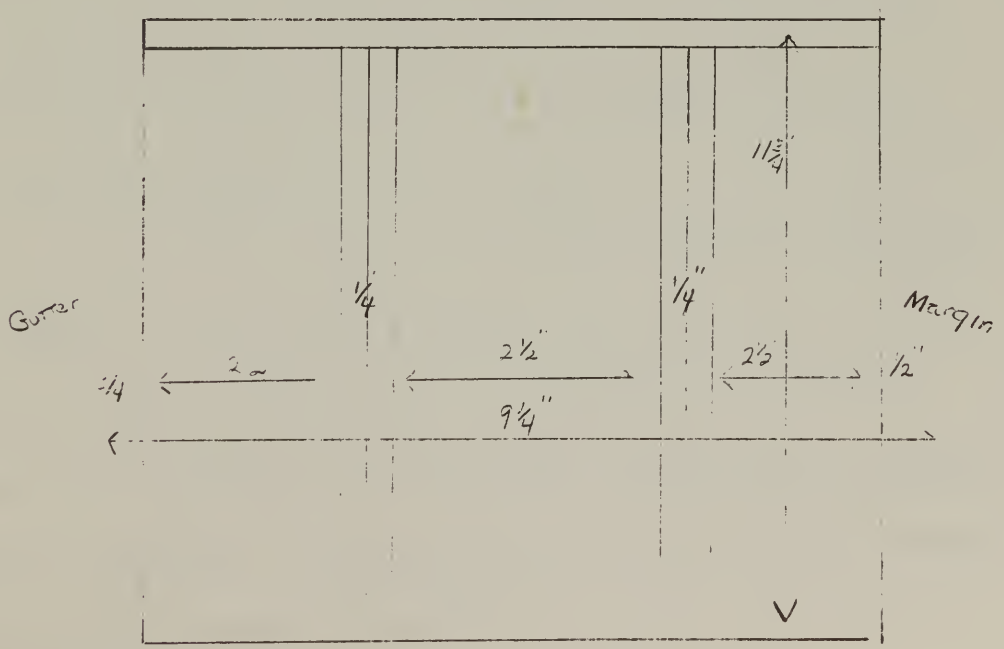
means of previously issued volumes of the index would be facilitated. Over a five year period or sooner, starting in 1960, the coverage of the new index would be increased steadily until a level of approximately 180,000 articles per year is reached.

Format. As a starting point, the hypothesis that the optimum arrangement would be by full citation under subject, with a separate author section, has been adopted. Despite the elimination of the contents listings in the Register of Articles Section with its concomitant scattering of the various parts of the entry throughout the three sections, an appreciable increase in the page space consumption of the new index would result. The resultant ease and flexibility of use of the complete unit citation and the overall economy attained would, however, serve as ample justification for the adoption of the new format.

The original intention was to have a main section in which the unit entries would be arranged under the various subject headings, plus a separate, less space consuming author index consisting of entries which would refer to the full citation in the subject section by means of a numerical address. The major problem encountered revolves around the determination, in advance, of the physical location of the subject entry to which the author index would refer. Among the location schemes which were tried and discarded were the use of a serial number, page, column, subject heading and various permutations

thereof. For a while it was hoped that the breakthrough to this problem would come from some ingenious machine talent to supply the location information readily without introducing a bottleneck into the system. These possibilities now appear quite remote.

Page Layout. In the determination of the layout of the printed page, there were also many factors to be considered and a proper balance maintained between pressures of economy, esthetics and the mass of bibliographic data. In order to get the maximum concentration of text into the index, different page sizes were studied and the standard Government Printing Office size of 9 1/4 x 11 3/4", slightly larger than the present Current List size, was finally selected as satisfactory from most viewpoints. The resultant 8" x 10" print area permits a three column layout of 2 1/2" per column with 1/4" between columns and 1 1/4" for gutters and margins as shown in Fig. 1;



The next task was to fit the bibliographic data into this framework in the most efficient and economical manner from the publishing end and most conveniently and legibly from the user's point of view.

Form of Entry. The unit of bibliographic data is the entry or citation, consisting of three basic elements: the title of the article, the authors and the bibliographic reference, which contains the journal title (in abbreviated form), the volume number, pagination and date of issue. The order, form and relative completeness of these elements may be juggled in various ways depending on the particular criteria operative in a given situation. It was clear from the outset that since space economy would, in this instance, be a paramount consideration, the entry would have to be held down to a minimum size. The clinching argument stemmed from the fact that the "Listomatic" Camera, being limited to the photographing of entries which contain no more than three lines would therefore require an additional trailer or "runover" card for all entries of greater length. It is not feasible to design an entry which will eliminate runovers entirely but to avoid placing a severe strain on the system it is obviously desirable to minimize their numbers. Initial trials indicated a 10% runover ratio which was held to be inacceptably high. A maximum level of 5% was accepted and a satisfactory form and size of entry was successfully designed on that basis. The basic form of the entry which emerged is shown in the examples in Figure 2.

ADLERSBERG D, SCHAEFFER L The interplay of heredity and environment in the regulation of circulating lipids and in atherogenesis.Am.J.Med.26:1-7,Jan59

BAYREUTHER H, RADTKE H Clinical experiences in reserpine therapy of schizophrenic psychoses with special reference to the relationship of somatic findings & EEG.Arch.Psychiat., Berl.198:158-80,1958 Ger

Fig. 2

In order to accomplish this end, all of the individual components of the entry were carefully measured and tabulated. The results proved to be extremely useful in the many manipulations of the entry that were made subsequently. Without these data the design of the entry and also of the punched card would have been almost entirely a matter of guesswork.

First, the periodical article titles were analyzed and found to consist of an average of 10 words with a range of from one to thirty-seven words. The words proper contained an average of 6.4 characters or 64 characters per title without allowing for spaces between the words. The average length of the title with one character space per word added therefore came to 74 characters.

The space consumed by the name of the author came to an average of 7.3 characters per surname or 11.3 characters after the initials and spaces are added; the range was from four to twenty-four characters. Since there are an average of 1.5 authors per periodical article, the space for 17 characters must be dedicated in the entry for this purpose. The dispersion

of a sampling of articles according to the number of authors per article proved to be as follows:

1 author	59%
2 authors	23%
3 authors	10%
4 or more authors	8%

The bibliographic reference - journal title abbreviation, volume number, pagination, date of issue and language symbol - came to an average total of 40 characters. The average journal title abbreviation consisted of 20 characters and 20 additional characters for the remainder of the reference which includes the designation for the original language of the article. The grand total for the complete entry consisting of all authors (surnames and initials only), a single version of the title and the bibliographic reference thus comes to an average of approximately 131 characters. The value of this item of intelligence in our investigations cannot be overestimated. For example, this information, together with other data subsequently collected, made it possible for the first time to estimate the number of pages required for the publication in the new format.

Mechanization

We come now to the discussion of the incorporation of mechanized techniques into the bibliographic publication system. The question whether some type of mechanized system

could be devised which would contribute substantially to the publication of a printed index is not difficult to answer. The feasibility of exploiting machines is easy to predict but the heart of the matter is the choice of the most suitable system for this specific purpose from among many alternatives. It is easy to lapse into the delusion that the quality and efficacy of a system is proportional to its degree of sophistication. It is entirely possible, however, to design an automated system on the highest technical level merely to find this to be a hollow achievement if the flow of operations does not proceed smoothly and naturally. This is more likely to occur where the majority of the machines used were not designed originally for this type of function.

Since this project has neither the resources nor the time to undertake the development of special machines capable of performing many complex operations, attention has been directed to fairly standard equipment available or to those items which are capable of being modified to special needs without exorbitant engineering costs or time consuming delays. The illusion of an abundance of suitable machines rapidly evaporates as their specifications are evaluated against the requirements for a compatible system. The ideal solution - if not the ideal system - from the operational standpoint is a compromise state somewhere between the technical tour de force and the unimaginative but

inexpensive setup which does not sufficiently exploit available techniques of mechanization.

The keystone of the entire system is the highspeed mechanized camera. Specifically, the photographic devices studied by the project are the Varityper Corp. "Foto-List" and the Eastman Kodak "Listomatic". Both cameras require the use of standard tabulating equipment punched cards as the vehicle for the introduction and manipulation of data in the system. In both systems the entry is typed onto an area at the top of a punch card and later fed into the camera which photographs the text on the cards in various desired reductions down to 50% to produce a photo offset negative. The "Foto-List" handles a single line of text on a card at a speed of about 100 cards (lines) per minute. The "Listomatic" can photograph entries ranging from one to three lines intermixed at a speed of 230 cards (up to 690 lines) per minute. The "Foto-List" appears to have certain technical advantages over the "Listomatic" as, for instance, in the superior quality of the finished negative; the greater ease and flexibility of accurately positioning the text on the card; the availability of a larger area of the card for punching. The fact that the "Foto-List", however, requires three separate cards for a three line entry is sufficient reason to disqualify it from further consideration in this project. Storage of the total

file would be a formidable enough problem but retrieval from such a store would assume heroic proportions. We will have more to say about the "Listomatic" later in conjunction with other technical aspects of the system.

The entire mechanized system may be divided into five broad phases:

1) The composing and imprinting of the entry on the card.

2) The coding and punching of the card.

3) The arranging and sorting of the cards in suitable order for publication.

4) The passage of the cards through the "Listomatic" Camera.

5) The processing and conversion of the film into manuscript form for photo offset plate making.

Operationally, these steps will, in the main, follow each other in the sequence listed above. The first and second phases may occur in reverse order depending on the particular system adopted, for it is entirely possible to do the punching first and the imprinting afterwards or visa versa. This order is ultimately determined by an analysis of a complex of factors such as the mechanical and human capabilities, costs and limitations, and the quality of the finished product. In either case, the end product is a coded and imprinted Hollerith card.

Composing & Imprinting. The space available for imprinting of text material on the punched card which may be photographed by

the Listomatic is contained within the area shown in Figure 3. The remainder of the card not used for text imprinting (and column 52) may be used for punching purposes. Within the camera field entries of one, two or three lines can be imprinted providing the proper type size, spacing and photographic reductions are selected. In a publication on as large a scale as ours, these factors become critical.

LISTOMATIC IMPRINTING AREA

Fig. 3

The significant requirements for the composition and imprinting operation are the following:

1. Type size. This is perhaps best expressed by the conception of a maximum concentration of characters in an area of printed matter rather than the more usual manner of describing

type size in terms of point size, vertical dimension or number of characters per unit of length.

2. Proportional spacing. In addition to absolute size of type another important aspect esthetically and economically is the typographic characteristic known as proportional spacing. In a standard or mono-spacing system, the same number of spaces or units are dedicated for all letters and numbers regardless of their relative widths. Consequently, the narrow "i" and the wide "w" occupy the same space and the linear capacity of the type font may be expressed in terms of the number characters per unit of length. In a proportional spacing system, on the other hand, available spaces or escapements vary with the requirements of each character and the number of characters per length unit will depend on the specific characters included in any given sample. Generally this will result in a saving of about 10% in terms of space consumed.

3. Type differentiation. The use of contrasting but compatible sizes and styles of type becomes quite important in a subject index which is made up of entries, subject headings, subheadings and cross references. By this simple means, the effective use of the index is enhanced substantially. This is accomplished by a judicious combination of roman, bold and italic fonts in upper and lower case.

4. Automatic repetition. The use of a rather complex unit citation which must be repeated intact several times indicates a need

of finding a means of automatically duplicating the entry instead of recreating it each time. For this reason, and others as well, punched paper tape composing machines such as the Friden Flexowriter, Remington-Rand Synchro-Tape, and Underwood Data Flo were studied.

5. Programming. The fact that it is necessary to type and also to punch several of the same elements of the entry suggested that it would be advantageous to perform one of these functions and automatically create the other as a by-product. To make such a conversion possible, the input must be provided with certain programming instructions which can be utilized in the imprinting and punching operations.

6. Positioning. The precise requirements of the camera make it essential that the entry be positioned on the card with the highest degree of accuracy. For this purpose, various special platens, and single and continuous card feeding techniques were investigated.

7. Photographic reproducibility. Imprinting on the card must be performed by means of carbon paper or carbon impregnated plastic tape ribbons which produce uniformly sharp and bold copy for the camera which will not smudge inordinately. This last requirement becomes an important consideration due to the need to pass the card many times through sorting machines which are not especially kind to the imprinted matter.

8. Justification. Right hand margin justification is a relatively minor luxury in a publication of this type. If it can be procured at a negligible cost in money or operational inconvenience it is doubtless a desirable addition to the rest of the system.

No single production typewriter has all of these features and only one tape operated machine, the Friden Justowriter, is capable of producing justified copy. Typewriters having substantial programmatic potentials are all monospacing machines and are limited to type styles which are not suitable for offset printing. These facts indicate the need for a compromise solution.

As regards type size, the two factors involved are, of course, height and width. The huge quantity of material to be included and the three line limitation of the Listomatic place a premium in this operation on condensed, i.e. horizontally compressed, type faces. This characteristic is generally expressed in several ways, point size for letter press, pitch for monospacing typography and unit escapement for proportional spacing machines. Pitch is measured in terms of characters per inch, i.e. 16 pitch is equivalent to 16 characters per inch. Unit escapement is based on the arbitrary assignment of specified number of horizontal divisions (units) for each character whose absolute width dimensions are expressed as fractions of an inch (escapement). For example, a 3 unit character in a type font

with a 1/48" escapement will occupy 1/16" horizontally; a 4 unit character in a 1/32" escapement type will, however, occupy 1/8" horizontally. Point size is a relative measurement which includes the leading (spacing) on the type body as well as the character itself. For example, the character height of an 11 point type with heavy leading might be equivalent to a normally leaded 10 point type. Finally, for the Listomatic, type size is determined in yet another way, by measuring the total vertical distance from the top of the tallest ascender to the bottom of the lowest descender. Appendix 1 shows the Listomatic dimensions in thousanths of an inch for the various IBM proportional spacing type styles. In addition to exploring available condensed type styles, considerable attention is being given to the development of specially cast fonts and portions of fonts in which known frequencies of letter occurrence may be capitalized on to yield a substantial saving in page space.

One interesting type of non-tape operated equipment investigated was the Vari-Typer with its attractive variety of type faces. Two types are always available by turning a control knob on the machine; others may be inserted into the anvil by the typist in a relatively simple operation. Horizontal spacing of characters is variable in 4 increments up to an escapement of 1/54 inch. Justification is computed automatically and leading

is variable from 0 to 18 points. Earlier difficulties in the use of the Model 160 to compose for the Listomatic Camera have been overcome by the introduction of the Model 100. This model has a specially designed card holder which accepts a standard punch card pre-punched with alignment holes in columns 1 and 80 of the Hollerith design. Registration is reasonably fool-proof and probably superior to that obtained from any other type of equipment. At the moment this model can only imprint one line of type on each card; however, a machine capable of imprinting up to three lines is about to be introduced.

Another example of non-tape operated equipment of interest is the Olivetti which has the unique feature of a replaceable carriage. Variation in typography is accomplished by transferring the carriage with copy inserted to another machine. Though the transfer of the carriage from one machine to another is relatively simple, its use as a production machine in a large scale printing project is impractical.

The repetitive nature of the composition work offers considerable promise in cost reduction in both typing and proofreading operations. There are probably three general ways that this can be done: By either photographic or Xerographic reproduction; by the simultaneous activation of "slave" machines; by the use of a recording of the original in some form such as punched paper tape.

The only feasible method at this time seems to be the use of tape operated typewriters, although the other methods were also explored. Among the reproduction methods, the only equipment which showed promise of transferring efficiently within the tolerances required was the IBM 938 Electrostatic Card Printer. This machine, operating at 200 cards per minute, is no longer available; precise information on its performance is lacking, but apparently serious technical problems were encountered in the high speed printing drum and the fusing process.

The Royal Robo-Tandem-Type which was studied as an example of "slave" equipment, consists of standard typewriters and a base unit containing the vacuum equipment for operating an auxiliary machine. The base unit is capable of use with monospacing machines other than those manufactured by Royal. Carriage return and keying of the slave machine are controlled from the master keyboard and limited programming is feasible. The slave machine can also be operated independently of the master machine from the slave keyboard. This type of equipment is designed primarily for the handling of lengthier, repetitive communications, such as letters. Consequently, relatively short bibliographic entries would give rise to major handling problems in the insertion and removal of cards from the various components of this system.

There are three basic types of tape composition machines, the input machines which produce the coded tape, the output machines

which are operated by the coded tape and the combined input - output machines. All machines investigated by the project were the fully perforated "chad" type machines equipped to handle either 5, 6, 7 or 8 channel tape. The current inclination is toward the 8 channel tape because of its compatibility with tape to card converters as well as its ability to handle more complex programming signals. In brief, 5 channel tape handles numbers and a single case of letters plus certain special characters; 6 channel handles both upper and lower case; 7 channel adds proportional spacing and code checking features and the 8 channel, complex programming. Readers and punches may be attached directly to the machines or housed in separate control units. Special attachments available on most tape operated typewriters include edge punched card punches and readers, Hollerith card readers, extra punch and/or read units, plug board programmers, automatic line finders and pin feed platens. Methods for tape correction include a delete code for characters, a line delete code as well as a means of repunching a new tape by a combination of automatic and key operations.

One of the most versatile of all tape operated equipment is the Underwood Data Flo System. Basic components include the Mastertyper (input), Servotyper (output), Servo-master (input-output) punch, reader, totalizer and programmer. Two programmers are available, equipped with plug boards, one with a maximum of 88

pre-determined program steps and the other with 275 steps. As many as 3 typewriters, 2 tape readers, 2 totalizers and a programming device can be assembled into a single system. Designed primarily for business procedures, the machines are mono-spacers and lack the condensed type styles desirable for the Listomatic system.

Another versatile machine of the programmatic type is the Remington Electronic Synchro-Tape Typewriter. An electric mono-spacing input-output machine, it may be synchronized with one or more punch and/or read electronic control units. The machine cannot be equipped with type more condensed than 16 pitch.

Friden Flexowriters are manufactured in a wide variety of models operating on 5, 6, 7 and 8 channel tape, and available with mono-spacing or proportional spacing in the double case models. There are three basic units, the Recorder (input), the Reproducer (output) and the Recorder-Reproducer (input-output). Automatic type-out from punched tape is done on the Reproducer at a rate of about 100 words per minute. Additional motorized tape readers, tape punches and card punches may be coupled to the machines. More elaborate programming is achieved through the use of the Programmatic model and the Selectadata reader. The Programmatic is at present a mono-spacing machine and available type faces are not regarded as suitable.

The Friden Justowriter, is a 7 channel Flexowriter, which also has the unique and fascinating ability of automatically justifying the right hand margins of the material typed on the Recorder. Eleven type faces ranging in size from 8 to 14 point are available on the Reproducer in escapements of 1/32, 1/36 or 1/48 inch. The Recorder and Recorder-Reproducer machines are limited to 8 type faces from 10 to 14 point with the single escapement of 1/32 inch. The maximum line which may be justified is 6 inches with 1/48 escapement, 8 inches with 1/36 escapement and 9 inches with the 1/32 escapement. The 1/48 escapement is only available with 8 point Newstype or Galvin, the 1/36 with 10 point Galvin only. Optional equipment includes automatic line finders, pin feed platens, edge punch attachments, etc. Limited programming for auxiliary equipment such as a tape to card converter is feasible; however, a converter similar to the Systematics C749 would probably be necessary for efficient operation.

The characteristics of each composition system are spelled out in specific detail for comparison purposes in a chart which appears in Appendix 2. This will serve also to illustrate graphically the nature of the problem encountered in choosing the most suitable equipment for the present system. What is needed is a composite of the machines which combines the strong

programming features offered by one with the desired typographic characteristics of another. Unfortunately such a device does not exist.

For the accurate positioning of the entry on the card by the Reproducer two methods have been examined. The continuous, pin feed platen combined with the Electric Line Finder is an excellent solution even though it does necessitate the use of a very expensive Card Cutter. In those systems which cannot utilize a continuous form but require the insertion of cards singly for imprinting, several platens collectively designated as "Card Holding" are available. Only the IBM Clamp Type Platen, however, which is fairly expensive and which requires skilled, semi-permanent installation is really satisfactory.

In order to obtain optimum photographic reproducibility and a minimum of smudging, trials of many commercially available ribbons are being conducted. Ten different ribbons have been collected for intensive naked eye and camera testing. Sample cards typed with each of the ribbons will be passed through the sorters, collators and Listomatic Camera many times; in addition, cards sprayed with an application of clear Krylon plastic will similarly be tested.

From the outset, both the IBM and Remington-Rand tabulating systems were considered as possibilities for the

project. The advantages and disadvantages of the card design and machine capabilities in each system were studied with conclusive results. The IBM card is divided into 80 columns vertically extending from the top of the card to the bottom; the Remington-Rand card consists of two 45 column fields, each occupying roughly one half, horizontally divided. Since the imprinted text occupies a substantial portion of the top of the card, a sizeable amount of card space is lost for punching purposes. In the IBM card this lost space precludes any alphabetical punching since the zone punches which convert the numerical codes to alphabetical codes in this system are located in the same area. The arrangement of fields on the Remington-Rand card, however, allows for alphabetical punching throughout the entire lower 45 column field.

In addition, the Remington-Rand equipment has other interesting and commendable attributes. The Electronic Sorter operates on the photo-electric cell principle instead of brushes which have an objectionable ability to smudge and scratch the cards as they pass through; the collator is able to perform a sequence check from either the primary or secondary feed during a simultaneous matching and merging operation; the key punch can also double as a verifier. Unfortunately, two essential functions cannot be obtained with Remington-Rand tabulating equipment, namely alphabetical collating and automatic designation of column

length. Consequently, the Remington-Rand system was eliminated from further consideration by the project and attention was directed to the IBM data processing equipment.

In regard to the type of coding required, for the Listomatic Camera proper only the codes in column 52, which are necessary in order to signal the appropriate opening of the aperture to encompass one, two or three line entries, must be punched. The Listomatic's use of a punched card as a vehicle suggested the possibility that it might provide a solution also to the Herculean sorting problem. The present inclination is to do this in the following manner: For the author section, the cards will be punched alphabetically for the author's surname and initials. Since the arrangement under subjects in the subject section is also by author, similar punching will be necessary also in the subject entry cards. Numerical codes for the subject headings and subheadings will be needed. In addition, all cards will be punched to indicate the year of publication and original language of the article; to facilitate the compilation of the Bibliography of Medical Reviews, review articles will also be indicated by a special punch on the card. Figure 4 shows the general design of the punched card with the various fields which we have described indicated.

The actual punching of the entry cards can be performed through one of three general methods: direct manual keying, use

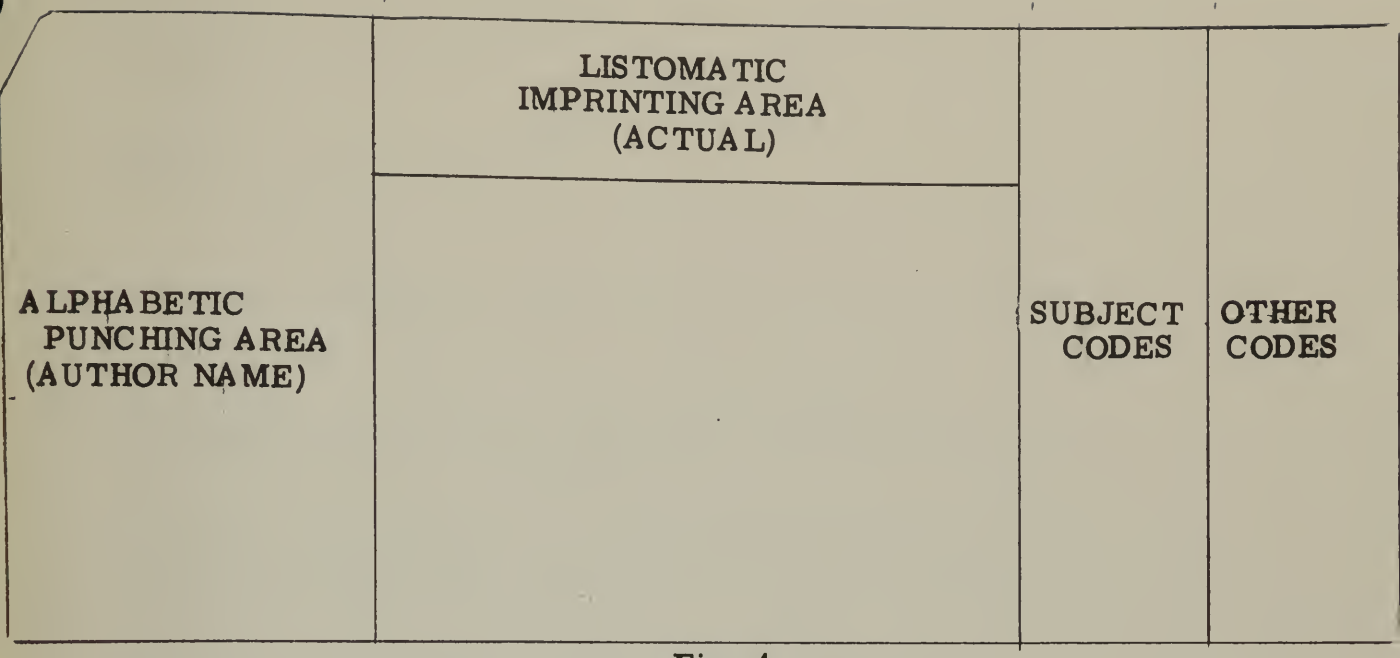


Fig. 4

of a mechanical tape to card converter, cable connecting a key punch directly to the composition machine. The second method was the first one studied by the project.

The IBM 046 tape to card converter which punches cards activated by either 5 or 8 channel tape codes showed considerable promise in the beginning. The problem of programming tapes to operate the reproducing composition machines and the tape to card converter is a complex one. The available input machines do not possess the necessary controls for programming as many variables as are needed. Consequently, there is a requirement to combine the tape activated punching with direct manual keying and this the 046 is unable to do in a single card cycle. Another deficiency of this machine for our purposes was its awkwardness in handling short lengths of tape rather than the long runs for which the machine was designed.

Efficient repetitive manipulation of short tape sections would require an Alternate Program Device and this attachment cannot be installed on the 046.

The use of cable connected punches activated simultaneously by the keying in the composition machine was also explored. The requirement of providing one or more separate key punches for each input composition machine raises grave economic objections; the fact that the greater part of the input (title and bibliographic reference) is composed for the visible entry but is not punched militates against the use of cable connected punches. The final solution will probably consist of a combination of manual key punching and a simple but effective exploitation of the standard automatic duplicating feature of the key punch.

In addition to the regular characteristics of the key punch, the IBM 026 Printing Punch, as its name indicates, simultaneously prints the characters across the top of the card. Fortunately, this "interpreting" is accomplished in a location entirely outside of the Listomatic imprinting area; consequently, this useful visible information can be provided without any risk of its being included in the exposed film. In addition, several special attachments to the 026 will be examined such as the Alternate Program Device which facilitates the

automatic punching and duplicating in the various types of cards which are required.

Another accessory mechanism known as the Self-Checking Number Device will also be investigated. This device may eliminate the need for one phase of the proofreading of the punched cards by providing a built-in method of verifying the numerical subject codes. This is done as follows: To the regular numerical code for the subject heading and subheading an additional check digit, mathematically predetermined, is added. The Self-Checking Number Device detects mismatches of a check digit with the parent code and signals the presence of an error requiring correction.

The whole proofreading operation will require careful attention. Two methods of checking the accuracy of punched cards are available: 1) machine verification, which is little more than a reiteration of the key punching operation on a machine which compares the key strokes with the original punched card; 2) visual inspection by a proofreader of the punched card and the instructions as given on the data sheet. At present, the latter method is favored.

In addition to the keypunching of entry cards, it will be necessary to punch codes for the subject headings, subheadings and cross references in order for these essential "non-entry" cards to be merged or removed from the total deck before and after publication. This is, however, a "one-shot" job, performed before the entire operation gets under way and merely maintained thereafter.

For the purpose of arranging the imprinted and coded cards into proper sequence prior to their run through the Camera, the 082 and 083 Sorters, the 101 Electronic Statistical Machine and the 108 Card Proving Machine are being studied. The 083 is considered more suitable than the 082 because of the higher speed, (1000 cards per minute versus 650); a minor advantage possessed by the 083 Sorter is the better degree of control during card jams which lessens the damage to following cards. The 101 has certain advantages in its ability to reduce the time consumed in alphabetical sorting by the use of a "length of name" sort; though its speed of 450 cards per minute is less than half as fast as the 083 Sorter, wear on the cards would be reduced substantially in alphabetical operations.

A collator is another essential component in the Listomatic system for its role in the sorting and machine editing operations. The collator is also used to indicate the length of columns in the printed page. It does this by means of a special "Code Accumulate Device" which counts the number of entry lines as indicated by the code in Column 52. When the predetermined number of lines in the column have been counted by the device, blank cards are automatically thrown in. After the film is processed, the roll can then be readily cut into columnar strips by means of the spaces provided for this purpose.

Improved scheduling of the sorting operation may be obtained through the combined use of one or more sorters together

with a collator. There are two aspects to this matter, the question of the total amount of machine time necessary for the job and the all-important matter of "end-time", i.e. the additional time necessary to complete the sorting and merging of the entire publication card deck after the cut-off of additional material. By performing several partial sorts and collations during the course of the month for the monthly issues and throughout the year for the cumulation the "end-time" can be substantially reduced. Progress has been made in this regard and study of the optimum coupling of machines and timing will continue.

We come now to that part of the system for which most of what has been described up to this point was destined. The Listomatic Camera occupies a tyrannical position in the system and virtually all aspects of the operation require subordination to its stringent requirements. Consequently, rigid limitations are imposed on the system which would be difficult to accept were it not for the overall benefits which the camera's use is expected to yield. The passage of cards through the Listomatic Camera itself is a deceptive operation in which, like the proverbial iceberg, only a small fraction of the whole picture is readily apparent. The prodigious effort that goes into the preparation of the cards and the camera settings only becomes

noticeable when something goes awry; otherwise, in a matter of an hour or two, the entire 400 foot roll of film is uneventfully exposed.

To the various Listomatic factors such as typographic size and precision positioning which have previously been discussed, several others should be added. Having selected a type style and ascertained its Listomatic vertical dimension (Appendix 1), the desired degree of photographic reduction and vertical line spacing must be determined. The table and diagrams in Appendix 3 illustrate how this is accomplished. To achieve the desired photographic reduction, various precise internal adjustments must be made in the Camera. The vertical line spacing is obtained by special film advance kits which come in sizes ranging from 6 to 14 lines per inch on the exposed film, which is available in 8, 4 and 2.67 inch widths.

After these decisions have been made, it is necessary to select the proper platen ratchet size which will compose the copy with the correct spacing between lines. This selection is aided by the table and instructions shown in Appendix 4. The interchange of the 35 available ratchets is relatively easily done although technical assistance and, in several instances, special parts are needed. It should be clear now how closely interwoven are all the facets of the Listomatic operation into a framework in which the alteration of one of the members necessitates a general revision. This is not especially disturbing in a large and continuing

operation which will remain undisturbed after it has once been set in motion.

After the cards have been run through the Camera, the film is removed for processing. From this point onward to the publication of the final product there are several alternate methods of submitting "copy" to the printer. One method is to have the entire roll of film converted into page galleys by the printer; this is, of course, the path of least resistance and of least control. A second possibility is, after receiving the processed roll of film, to cut and identify the column lengths, place each page in a separate envelope and ship the entire manuscript off to the printer in this form. Finally, the originating agency may go a step further and, itself "strip" up the cut columns into page form complete with folio and running head indications, ready for offset plate making.

System Development

Because of the difficulty in obtaining precise information on potentialities and limitations of the various components studied, and the apparently limitless number of possible solutions, the development of an effective system has been in a state of flux until quite recently. Various and sundry ways of arranging the flow of work into a smoothly functioning system have been considered.

With the passage of time, however, the opportunity to utilize extensive automation methods waned as the available equipment was evaluated in terms of feasibility and cost. Fortunately, some of the simpler mechanized techniques appeared to be more effective for this type of bibliographic publication system. Appendix 5 shows a graphic representation of the general outlines of a proposed system developed by the project which appears to be promising. The commentary follows:

The first and inescapable step would be the indexing itself, involving the selection of subject headings and subheadings. This operation will consist of the selection of the indexable article from the journal piece, the translation of the title, if in a foreign language, and the analysis of the content of the article in order to derive the necessary main subject headings and subheadings. This information will be entered on a "data sheet" which, together with the journal proper will, upon clearing this work station, move on to a sub-professional assistant.

The indexing assistant's prime function is to conserve the valuable time of the indexer by supplying the descriptive bibliographic data and machine codes. The correct form of the authors' names will be indicated in the journal or, if transliteration is required, on the data sheet. The various parts of the bibliographic citation - official journal title abbreviation, volume number, pagination, date of issue

and foreign language symbol - will be affixed to the data sheet. Finally, the indexing assistant will convert the alphabetical subject headings and subheadings to numerical codes to facilitate their manipulation in the machines.

The data sheet and the journal next move to an operator who will generate "hard copy" and simultaneously, the coded paper tape, on a 12 point Justowriter Model AA. The hard copy will be used to proofread the tape which will serve as a recording to be used later for the purpose of imprinting the entry repetitively. This material is keyed in the following sequence:

1. Senior author name
2. Junior author names
3. Title of article in the English language
4. The complete bibliographic reference
5. See-references from a junior author to the senior author.

Next, the tape, hard copy, data sheet and journal are transported to the proofreaders. It should be noted that although the hard copy is in a 12 point type size to facilitate the proofreading, the publication version will be in 8 point, but in exactly the same spatial relationship. In addition to indicating errors located in the hard copy, the proofreader will also add the Listomatic code for the number of lines in the entry, and segregates two categories of material earmarked for a special handling procedure. One category includes the entries in excess of three lines which require runover cards; the other group marked

for special treatment consists of review articles which require approval for inclusion in the Bibliography of Medical Review at this stage while the journal is still available. Having performed these operations the journal may now be added to the Library collection and the hard copy, data sheet and tape go on to the key punching station after the necessary corrections have been made.

Key punching of the individual cards begins with the preparation of the subject entry cards which may be performed in the following manner: First, the surname of the senior author is punched in columns 1-18, the author's two initials in column 19 and 20. The Alternate Program Device of the 026 Key Punch skips the card to column 52 where the Listomatic code is entered and the card skips again to column 61 through 71 where the six digit code for the main heading (five digits for the actual code plus the check digit) and the four digit subheading code (three plus the check digit) are punched. The last digit of the year of publication, the foreign language and review article codes are then punched and the card skips out to the reading station and the succeeding card enters the punching position in the machine. With the exception of the subject codes which differ from card to card and must therefore be manually punched individually, the remainder of the punching of the subject entry cards may be accomplished by automatic duplication.

The author entry cards may then be prepared with the aid of the Alternate Program Device. First, the senior author card

(60% of the time this is the only author entry card) is punched starting with the automatic duplication of the author's name from the last subject card. The Listomatic code is put in similarly but here the Alternate Program Device provides for skipping across columns 61 thru 71 since there are no subject codes to be punched.

The accuracy of the punching of the subject codes is checked by the Self-Checking Number Device; the author cards may be proofread visually from the information printed across the top of the card by the Printing Card Punch. After corrections have been made the cards are ready to receive the appropriate imprinted entry in the Listomatic area at the top of the card.

Tape, cards and data sheet go to the next station which consists of a battery of 8 point Justowriter Reproducers fitted with clamp-type card holding platens. The complete entry portion of the tape is inserted in the reader, the corresponding card is inserted in the platen and the machine is instructed to begin typing by "reading" from the recorded entry in the punched paper tape into the exact location on the card. When there are three or more such repetitions required, it will probably be advisable to loop the tape by bonding the free ends with an adhesive. After the complete entry cards (the senior author and all subject cards) have been imprinted, the shorter tapes for the

junior author cross reference entries are matched with their appropriate cards, inserted into the Reproducer and "read" onto the cards. At the rate of about 100 words per minute the Reproducer types out justified copy. The cards are inspected and filed away awaiting their sorting at a later date.

The next link in the chain is the mechanical sorting and interfiling of the entries with selected headings and cross reference cards using IBM sorters and collators. Author and subject decks may be processed separately. The sorting procedure for the author section might capitalize on the variation in length of the authors' names. The object here is to sort on that column which will divide the deck into two parts, those cards containing many blank columns and those which do not. It may be desirable, for example, to sort a name with 15 letters on 15 columns but this is not true for names of 5 or 6 letters in length. Without an analysis of a typical author deck it is difficult, however, to predict which column would be best to select for this purpose.

After the entire author deck has been alphabetically arranged, it is passed through a collator which is equipped with a Code Accumulate Device. The Listomatic codes are read and after each 100 lines, blank spacer cards are interspersed which will later facilitate the cutting of the processed film into

columnar strips. At this point, the author deck is ready to be passed through the Listomatic Camera.

Sorting of the subject cards is a considerably more complex affair. Alphabetizing of this deck would not be preceded by a preliminary "length of name" sort since there are relatively few entries under a single main heading and subheading. Perhaps five or six columns could be used, followed by a numerical sort by subheading and then by main heading. (Machine sorting generally proceeds from right to left). At the end of this sort, all cards would be in order by alphabetical subject heading and within each subheading alphabetically by senior author. To complete the subject section deck, the necessary "non-entry" cards, i.e. main headings, subheadings, "see" and "see also" cross references must be added. Briefly, this may be done as follows:

A master deck of all "non-entry" elements is prepared at the outset, fully imprinted and punched. The subject headings in the master deck are matched against the subject entries in the collator and those for which entries are present will fall into one pocket while those which have not been used will drop into another pocket. The entries proper will wind up intact in a third pocket. The selected master main headings are then matched with the complete master cross reference deck,

(arranged in order of the member referred to) and the unused cross references are separated by the collator from those selected for inclusion in the index. Next, the selected master cross references are rearranged in the order of the member referred from, as it will actually appear in print, and then merged with the selected master main headings. The total selected master deck of headings and cross references is then merged with the previously filed subject entries. The line counting operation which was performed on the author deck is now repeated on the subject deck and the final passage through the camera can now take place. The exposed film may then be sent to the photo laboratory for processing and upon its return cut into columns in preparation for the page make-up.

Bibliographic Retrieval System

The two fundamental characteristics of basic periodical indexes covering broad areas of the sciences are comprehensive listing and rapid communication through prompt publication. In an index such as the present Current List of Medical Literature only an initial sifting of the material into subject categories can be achieved. The needs of more restricted subject fields may, however, often require the analysis of a selected segment of the material at a greater depth than is feasible in the more

comprehensive index. The limited service is often dependent to a great degree on the larger index for the original discovery, scanning and arrangement of its material. It is desirable, therefore, to study means by which the more circumscribed subject field may make use of the work already accomplished by the broad service, without needlessly and expensively re-tracing ground already covered.

When the project got under way, the intention was to study the bibliographic retrieval system simultaneously with the publication system with the aim of utilizing the camera ultimately selected to provide bibliographic listings of selected portions of the file as well as for the publication process itself. For several months this objective was pursued based on two hypotheses: the use of a single, master card for each article containing all the derived subject codes and, secondly, a subject categorization separate from the system of headings and cross references used in the subject section of the published index.

The most compelling argument for the use of a single master card to represent the indexed article, is the resulting size of the card file in a system as large as this. Since the average number of subject entries per article is about three, the difference in size between the two systems

would involve a factor of three. Even without considering the quantitative implications of the projected expansion of coverage this becomes a telling argument for the master card. The present Current List, for example, would yield about 1,650,000 individual subject entry cards over a five year period as compared with 550,000 master cards. The 1,100,000 card differential is no small item even in a considerably more sophisticated data processing system. Another reason for considering a master card was the apparent availability of space on the card for punching multiple subject codes after the requirements for the publication system had been met. This approach still shows the most promise and further investigation will continue along these lines.

In regard to the subject coding proper, the initial assumption was that a system entirely separate from that used in the publication system would be desirable. On the one hand, although the input would be complicated by a dual subject analysis procedure in which the indexer would be required to furnish headings derived from two sources and based on two sets of criteria, the output, however, would be simplified due to the direct encoding of the material in the form needed for its retrieval. On the other hand, the simplification of the indexing input by using only the

subject heading authority list of the printed index would necessitate devising a special means of searching the file effectively.

To investigate this problem, several subject categorizations were compiled based on the following specifications: The total number of categories and their equivalent codes had to be small enough for them to be remembered and effectively used by the indexing staff. This was arbitrarily set at between 150 and an absolute maximum of 300 categories. Secondly, these categories had to be carefully selected in order to provide for the retrieval of the desired listings. To obtain additional data on the type of search the system might be called upon to make, a special study was undertaken to tabulate, by subject, all large scale medical bibliographies compiled during the last decade as indicated by their inclusion in the National Library of Medicine Catalog.

After several months spent in studying the mechanical and intellectual phases of the bibliography retrieval system, the decision was made to concentrate first on the resolution of the problems presented by the publication system. A full scale investigation of the feasibility of a bibliographic retrieval system will recommence shortly.

APPENDIX 1

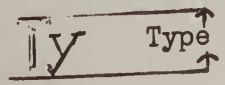
FACTORS IN DETERMINING TYPE SIZE ON THE LISTOMATIC CARD

CODE IBM		NAME	SIZE DIMENSION ON LISTOMATIC CARD
16		Boldface No. 1	.152
26		Secretarial	.150
32		Modern	.140
40		Documentary	.145
46		Copperplate Gothic	.1045
47		Text	.122
50		Mid-Century	.1555
51		Charter	.1105
57		Boldface No. 2	.1385
59		Boldface Italic	.1575
61		Heritage	.1415
65		Registry	.158
65	(F2)	Registry	.1395
66		Directory	.2055
71		Testimonial	.162
79		Arcadia	.134

"Point size" is an approximate designation for size of type. For Listomatic use, type *height on the card must be accurately determined in thousandths of an inch.

In addition to the accurately determined type height, .010 of an inch must be allowed for proper tolerance in the photographic field on the Listomatic card.

* Type height is determined by measuring the top of the tallest Character to the bottom of the lowest Descender.

Example 

APPENDIX 2

PUNCHED TAPE TYPEWRITERS

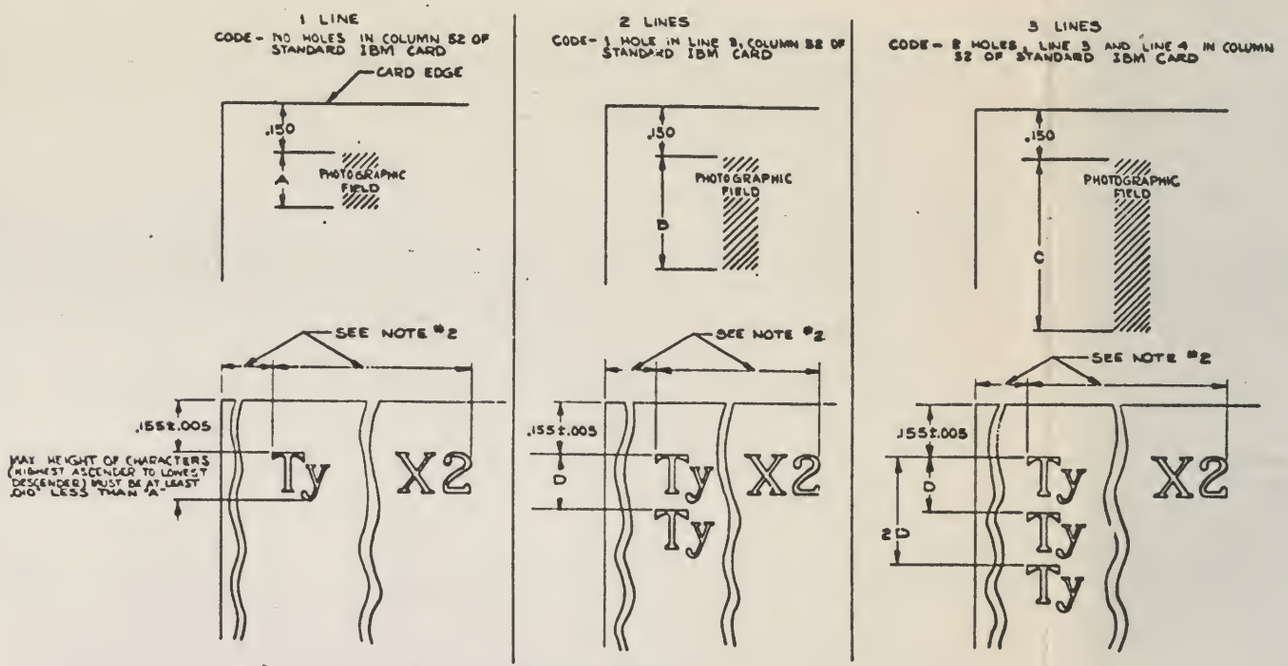
COMPARISON OF PRINCIPAL FEATURES AND FUNCTIONS

RT 8962

	5 LEVEL TAPE CODES	6 LEVEL TAPE CODES	7 LEVEL TAPE CODES	8 LEVEL TAPE CODES	VARIABLE TAPE LEVELS, PUNCHING & READING	AUTOMATIC PRECEDENCE CODE - 5 LEVEL	SINGLE TAPE PERFORATION	MULTIPLE TAPE PERFORATION	SINGLE TAPE READING	MULTIPLE TAPE READING	SINGLE EDGE PUNCHED CARD PERFORATION	MULTIPLE EDGE PUNCHED CARD PERFORATION	SINGLE EDGE PUNCHED CARD READING	MULTIPLE EDGE PUNCHED CARD READING	VARIABLE EDGE PUNCHED CARD CODE LEVELS PUNCHING AND READING	MANUAL TYPING	90 COLUMN TAB CARD PUNCH ATTACHMENT	80 COLUMN TAB CARD PUNCH ATTACHMENT	90 COLUMN TAB CARD READER	80 COLUMN TAB CARD READER	HARD COPY - MASTER TYPEWRITER	HARD COPY - SLAVE TYPEWRITER	LIMITED PROGRAMMING FACILITIES	EXTENSIVE PROGRAMMING FACILITIES	INTERNAL COMMUNICATION SYSTEM	PAPER TAPE OUTPUT FOR TRANSMISSION	PAPER TAPE OUTPUT FOR COMMUNICATION MACHINE	PAPER TAPE OUTPUT FOR TELEDATA	PAPER TAPE OUTPUT FOR TAPE-TO-CARD CONVERTERS	TAPE READING & TYPING	CALCULATING FEATURE	KEYBOARD CAPACITY	CONTROL KEY CAPACITY	TYPEWRITER STANDARD CARRIAGE WIDTH	SINGLE & DOUBLE CASE TYPEWRITER	OPTIONAL PIN FEED PLATEN ATTACHMENT	RIGHT MARGIN AUTO JUSTIFICATION	ADVANCED FEATURES OF TYPEWRITER	SEPARATE UNIT TRANSLATER	ELECTRONIC OPERATION	AUTOMATIC PARITY CHECK OPTIONAL FEATURE-PUNCH	AUTOMATIC PARITY CHECK OPTIONAL FEATURE-READER	CHADLESS TAPE PUNCH	CHADLESS TAPE READER	CHADLESS TAPE PRINTING INTERPRETATION
REMINGTON RAND SYNCHRO-TAPE TYPEWRITER	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	YES	NO	NO	YES	NO	YES	YES	YES	YES	660	NO	44	14	13"	YES	YES	NO	YES	YES	YES	YES	YES	NO	YES	NO
FRIDEN FLEXOWRITER MODEL FL	NO	YES	NO	NO	NO	NO	YES	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	572	NO	42	6	12"	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
FRIDEN FLEXOWRITER MODEL FC	YES	NO	NO	NO	NO	NO	YES	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	NO	572	NO	26	4	12"	D	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
FRIDEN FLEXOWRITER MODEL FG	YES	YES	NO	NO	NO	NO	YES	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	YES	572	NO	42	8	12"	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
FRIDEN FLEXOWRITER MODEL FPC5	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	NO	572	NO	42	8	12"	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
FRIDEN FLEXOWRITER MODEL FPC8	NO	NO	NO	YES	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	YES	YES	NO	572	NO	42	8	12"	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
FRIDEN PROGRAMATIC FLEXOWRITER MODEL FPC5	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	NO	YES	NO	NO	YES	NO	YES	YES	YES	NO	572	NO	42	8	12"	YES	YES	NO	NO	NO	NO	YES	YES	NO	YES	NO
FRIDEN PROGRAMATIC FLEXOWRITER MODEL FPC8	NO	NO	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	NO	YES	NO	NO	YES	NO	NO	YES	YES	NO	572	NO	42	8	12"	YES	YES	NO	NO	NO	NO	YES	YES	NO	YES	NO
FRIDEN PROGRAMATIC FLEXOWRITER MODEL FTCP8	NO	NO	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	YES	NO	NO	YES	NO	NO	YES	NO	NO	YES	YES	NO	572	NO	42	8	12"	YES	YES	NO	NO	NO	NO	YES	YES	NO	YES	NO
FRIDEN COMPUTYPER	YES	NO	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	NO	YES	NO	NO	YES	NO	YES	YES	YES	NO	572	YES	42	8	12"	YES	YES	NO	NO	NO	NO	YES	YES	NO	YES	NO
FRIDEN JUSTOWRITER	NO	NO	YES	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	572	NO	42	6	12"	YES	YES	YES	NO	NO	NO	NO	NO	NO	YES	NO
FRIDEN FLEXOWRITER MODEL FTM (SPECIAL)	NO	YES	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	YES	YES	NO	YES	NO	YES	NO	NO	572	NO	42	6	12"	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
IBM TYPE 884	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	YES	YES	NO	—	NO	42	—	12"	S	YES	NO	YES	NO	NO	YES	NO	NO	YES	NO
IBM CARDATYPE	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES	NO	YES	YES	NO	YES	NO	NO	NO	YES	YES	NO	—	NO	42	—	12"	YES	YES	NO	YES	NO	NO	YES	NO	NO	YES	NO
TELETYPEWRITER	YES	NO	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	YES	YES	YES	YES	NO	360 PLUS	NO	26	—	$8\frac{2}{7}$"	D	YES	NO	NO	NO	NO	NO	NO	YES	YES	YES
TELETYPESETTER	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	NO	NO	360 PLUS	NO	60	—	$8\frac{1}{4}$"	D	YES	NO	NO	NO	NO	NO	NO	NO	YES	NO
UNDERWOOD DATAFLO	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES	YES	NO	YES	NO	YES	YES	YES	NO	572	NO	43	—	12"	YES	YES	NO	YES	YES	YES	NO	NO	NO	YES	NO

(Remington-Rand)

APPENDIX 3
LISTOMATIC CARD LAYOUT



PHOTOGRAPHIC FIELDS FOR KODAK LISTOMATIC CAMERA CARDS
PRINTED PAGE LINES/INCH VS. REDUCTION RATIO

PRINTED PAGE LINES/INCH	FILM ADVANCE	CLEAR FILM		% OF ORIGINAL SIZE	100%	91%	83%	77%	71%	67%	62%	59%	55%	52%	50%	48%	45%
				% REDUCTION	0	9%	17%	23%	29%	33%	38%	41%	45%	48%	50%	52%	55%
				REDUCTION RATIO	1.0X	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2
				PHOTOGRAPHIC FIELD ON CARDS													
6	164	156	A		156	171	187	202	218	234	249	265	280	296	312	327	343
	328	320	B		320	352	384	416	448	480	512	544	576	608			
	493	485	C		485	533	582	630									
			D		164	180	196	213	229	246	262	278	295	311			
7	141	133	A		133	146	159	172	186	199	212	226	239	252	266	279	292
	282	274	B		274	301	328	356	383	411	438	465	493	520	548	575	602
	423	415	C		415	456	498	539	581	622							
			D		141	155	169	183	197	211	225	239	253	267	282	296	310
8	124	116	A		116	127	139	149	162	174	185	197	208	220	232	243	255
	247	239	B		239	262	286	310	334	358	382	406	430	454	478	501	525
	371	363	C		363	399	435	471	508	544	580	617					
			D		124	136	148	161	173	186	198	210	223	235	248	260	272
9	110	102	A		102	112	122	132	142	153	163	173	183	193	204	214	224
	220	212	B		212	233	254	275	296	318	339	360	381	402	424	445	466
	329	321	C		321	353	385	417	449	481	513	545	577	609			
			D		110	121	132	143	154	165	176	187	198	209	220	231	242
10	101	093	A		93	102	111	120	130	139	148	158	167	176	186	195	204
	202	194	B		194	213	232	252	271	291	310	329	349	368	388	407	426
	303	295	C		295	326	354	383	413	442	472	501	531	560	590	619	
			D		101	111	121	131	141	151	161	171	181	191	202	212	222
11	090	082	A		082	090	098	106	114	123	131	139	147	155	164	172	180
	181	173	B		173	190	207	224	242	259	276	294	311	328	346	361	378
	272	264	C		264	290	316	343	369	396	422	448	475	501	528	554	580
			D		090	099	108	117	126	135	144	153	162	171	180	189	198
12	084	076	A		076	083	091	098	106	114	121	129	136	144	152	159	167
	167	159	B		159	174	190	206	222	238	254	270	286	302	318	333	349
	251	243	C		243	267	291	315	340	364	388	413	437	461	486	510	534
			D		084	092	100	109	117	126	134	142	151	159	168	176	184
13	079	071	A		071	078	085	092	099	106	113	120	127	134	142	149	156
	158	150	B		150	165	180	195	210	225	240	255	270	285	300	315	330
	237	229	C		229	251	274	297	320	343	366	389	412	435	458	480	503
			D		079	086	094	102	110	118	126	134	142	150	158	165	173
14	071	063	A		063	069	075	081	088	094	100	107	113	119	126	132	138
	142	134	B		134	147	160	174	187	201	214	227	241	254	268	281	294
	213	206	C		205	225	246	266	287	307	329	350	370	391	412	432	453
			D		071	078	085	092	099	106	113	120	127	134	142	149	156

NOTES:

1. TYPE TO BE PHOTOGRAPHED MUST BE WITHIN THE PHOTOGRAPHIC FIELD LIMITS SHOWN (SEE TABLE FOR ACTUAL DIMENSIONS BASED ON LINES PER INCH AND REDUCTION RATIO.)
2. LENGTH OF LINE MUST BE THE PRINTED LINE LENGTH X THE REDUCTION RATIO. MAXIMUM LINE LENGTH IS 7.000". LINE MUST BE CENTERED ON CARD LENGTH.
3. "D" MUST BE FIGURE SHOWN IN TABLE FOR EVEN LINE SPACING FOR MULTIPLE CARD ENTRIES. "D" MAY BE LESS THAN FIGURE SHOWN WITH THE RESULT BEING CLOSER SPACING FOR LINES ON THE SAME CARD THAN BETWEEN SEPARATE CARDS. THIS IS SOMETIMES ADVANTAGEOUS FOR DIRECTORY LISTINGS WHERE NAMES AND ADDRESSES ON THE SAME CARD WILL APPEAR AS A GROUPING.
4. THE PHOTOGRAPHIC FIELDS OF 2 AND 3 LINE CARDS ARE PHOTOGRAPHED AS SINGLE AREAS SO THAT COLUMN HEADINGS ETC. MAY BE TYPE AS HIGH AS THE FIELD HEIGHT. IT IS ALSO POSSIBLE TO TYPE MORE THAN 3 LINES IN THE AREA OR TO INCLUDE SUCH ITEMS AS EQUATIONS ETC.
5. FILE CARDS MUST BE STANDARD MACHINE ACCOUNTING CARDS, 7⅜", 3¼" X .007", WHITE.

(Eastman Kodak)

APPENDIX 4
PLATEN RATCHETS AND LINE SPACING

Platen Ratchet	1 Tooth	2 Teeth	3 Teeth	4 Teeth	5 Teeth	6 Teeth
* 29	5.28	2.64	1.76			
* 33	6.00	3.00	2.00			
34	6.18	3.09	2.06			
35	6.37	3.18	2.12			
36	6.55	3.27	2.18			
37	6.73	3.37	2.24			
* 38	6.91	3.46	2.30			
39	7.09	3.55	2.37			
40	7.28	3.64	2.43			
* 41		3.73	2.49	1.86		
42		3.82	2.55	1.91		
43		2.91	2.61	1.95		
* 44	8.00	4.00	2.66	2.00		
45	8.18	4.09		2.05		
46	8.37	4.18		2.09		
47	8.55	4.28		2.14		
48		4.37	2.91	2.18	1.75	1.46
49		4.46	2.97		1.78	
50		4.55	3.03	2.27		1.52
51		4.64	3.09	2.32		
52		4.73	3.15	2.37		1.58
53		4.82	3.21	2.41		
54		4.91		2.46		1.64
* 55		5.00	3.33	2.50		
56		5.09	3.40	2.55		1.70
57		5.18	3.46	2.59		
* 58		5.28	3.52	2.64		1.76
59		5.37	3.58	2.68		
60		5.46	3.64	2.73		1.82
61		5.55	3.70	2.77		
62		5.64	3.76	2.82		1.88
63		5.73	3.82	2.87		
64		5.82	3.88	2.91		1.94
65		5.91	3.94	2.96		
* 66		6.00	4.00	3.00		2.00

* These ratchets are considered standard and are supplied at no additional charge. All others: $12.75 approximately.

To Determine Proper Typewriter Ratchet:

1. Choose the type style which is most appealing. This is a matter of judgment on the part of the user.

2. Determine either the point size of the finished product or the number of lines per inch.

3. From the Recordak Listomatic Card Guide read either from reduction ratio or lines per inch the "A" distance closest to .010 in excess of the size of the type chosen in (1) above. (This will determine either the proper reduction ratio or lines per inch depending on which was the determinant in (2) above.)

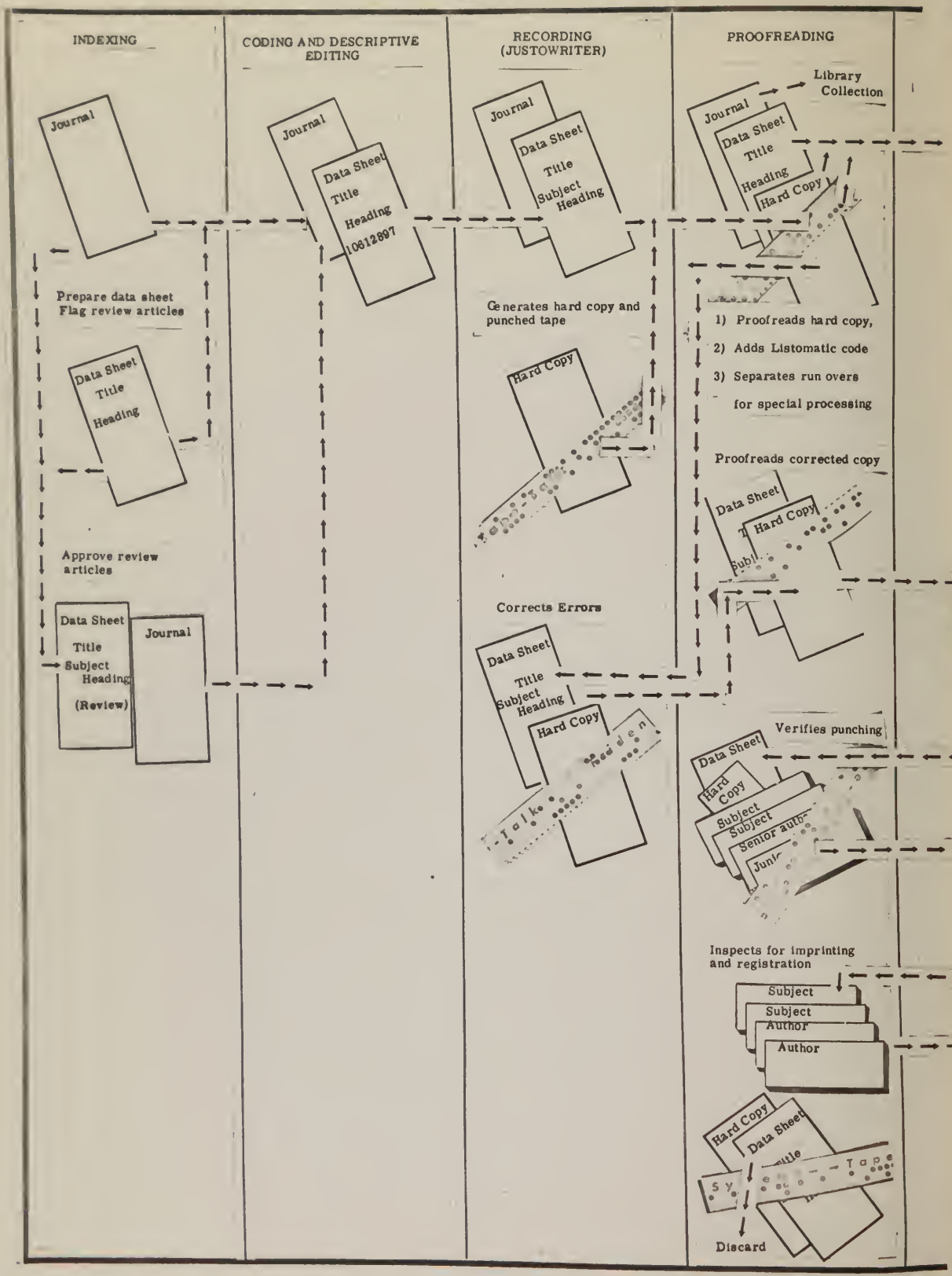
4. From the Recordak Listomatic Card Guide read the "D" figure for the reduction ratio and lines per inch determined in (3).

5. Divide this figure into 1. The result will be the number of lines per inch necessary in the original typing to accord with Listomatic spacing of the final product. (The proper ratchet can now be selected from the chart above, finding a figure which is the same as that determined in (5) or the next lowest figure.)

(Recordak)

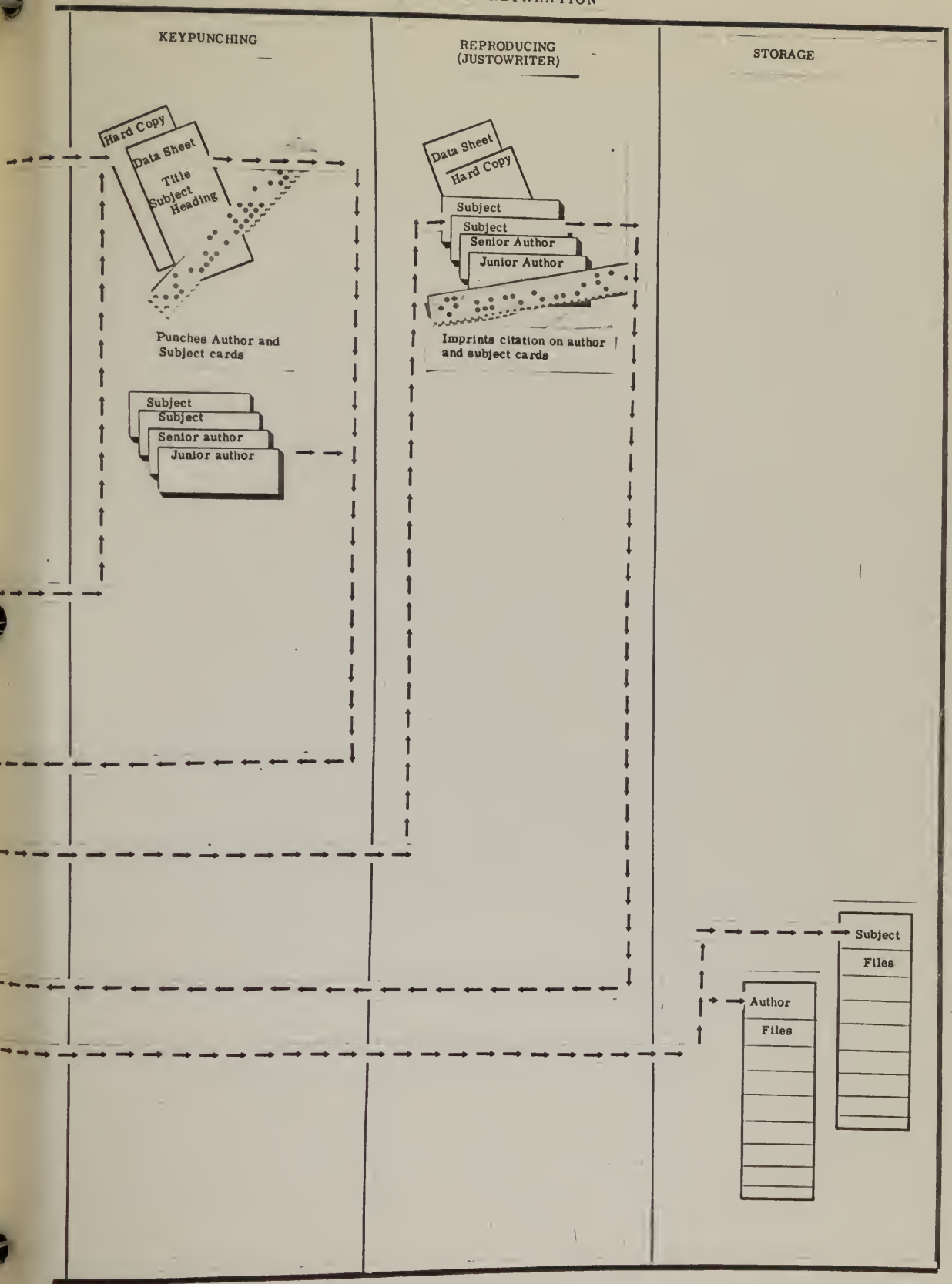
APPENDIX 5-A

CARD PREPARATION



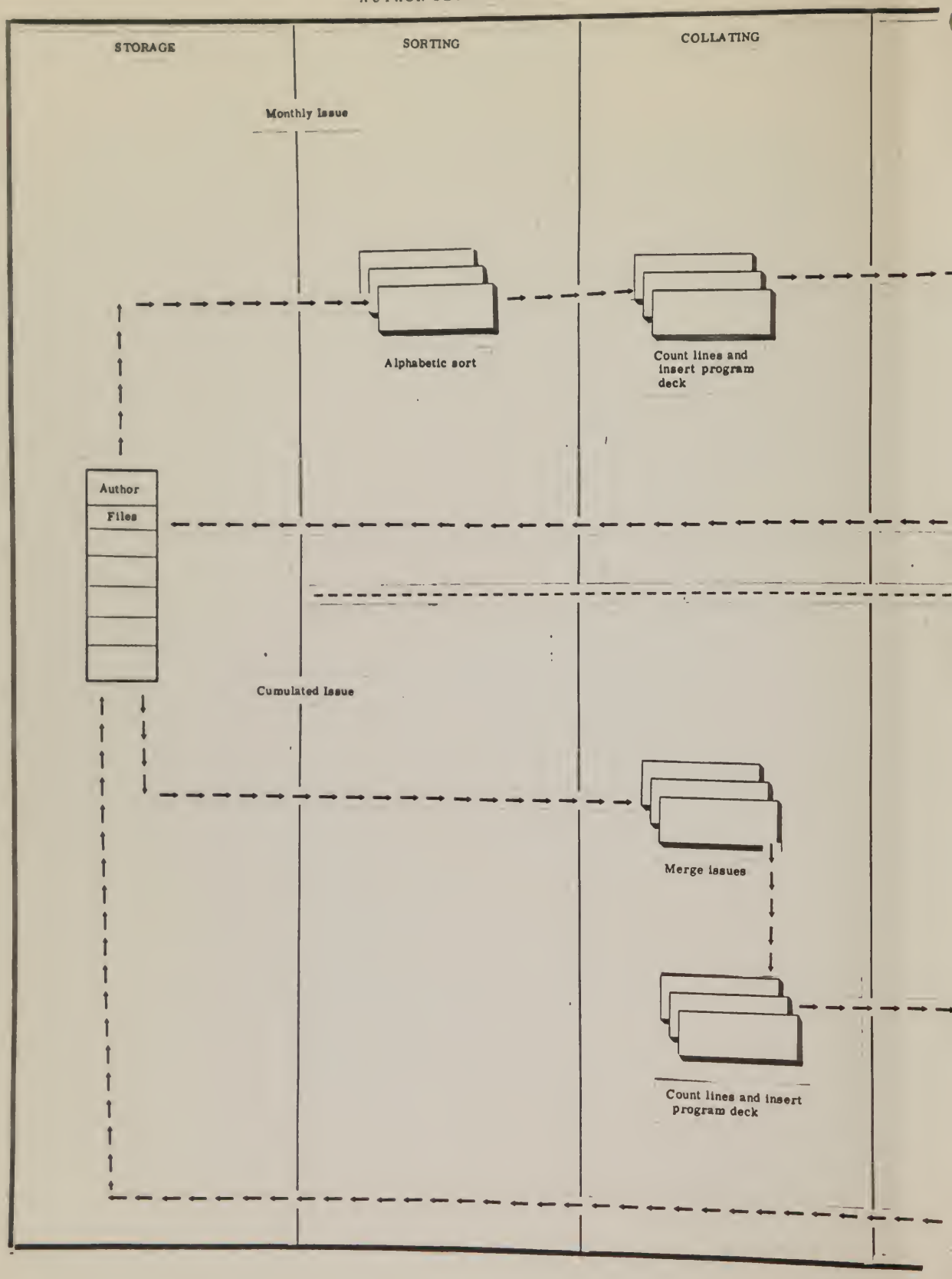
APPENDIX 5-A

CARD PREPARATION



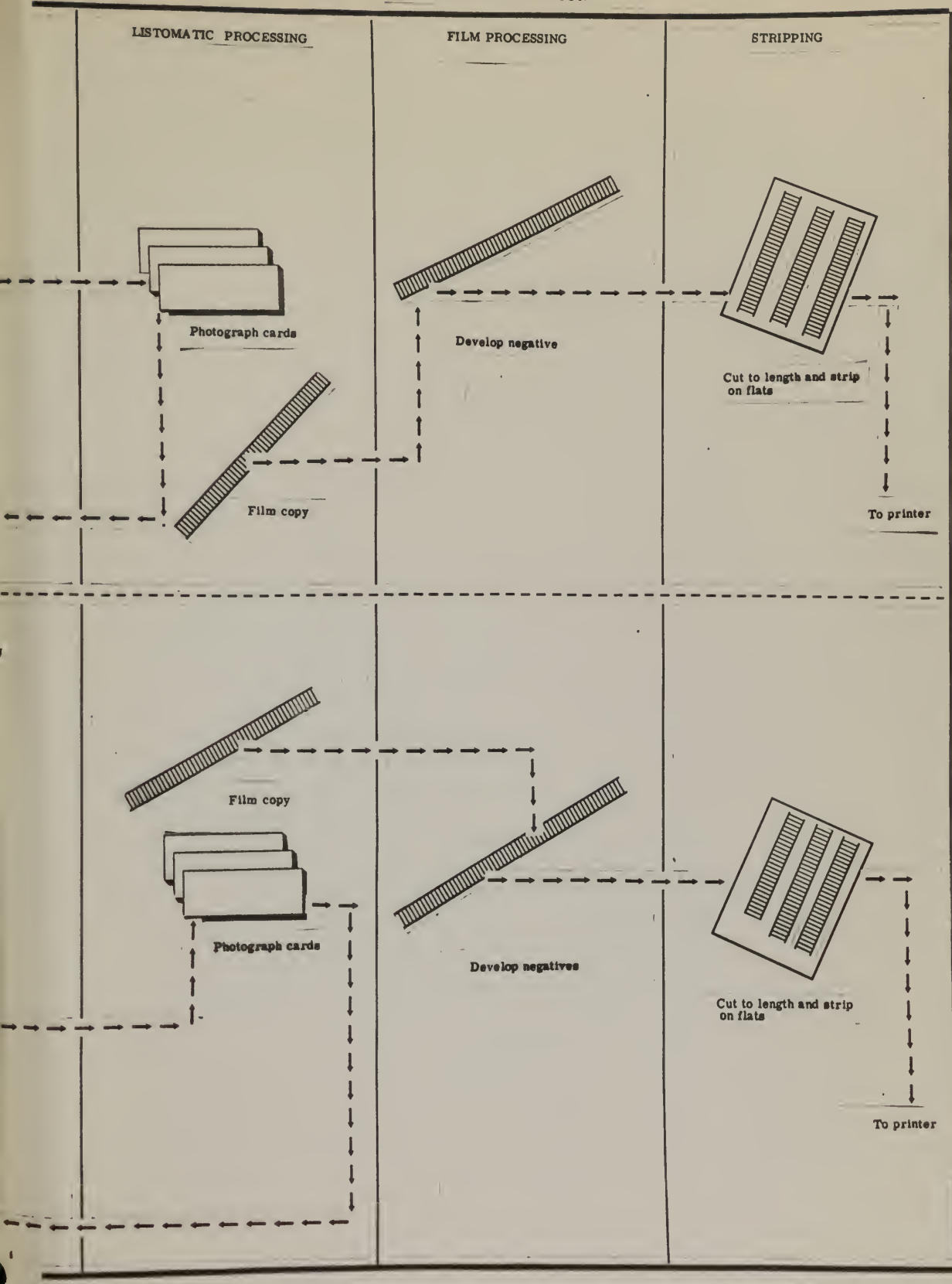
APPENDIX 5-B

PREPARATION FOR CAMERA:
AUTHOR SECTION



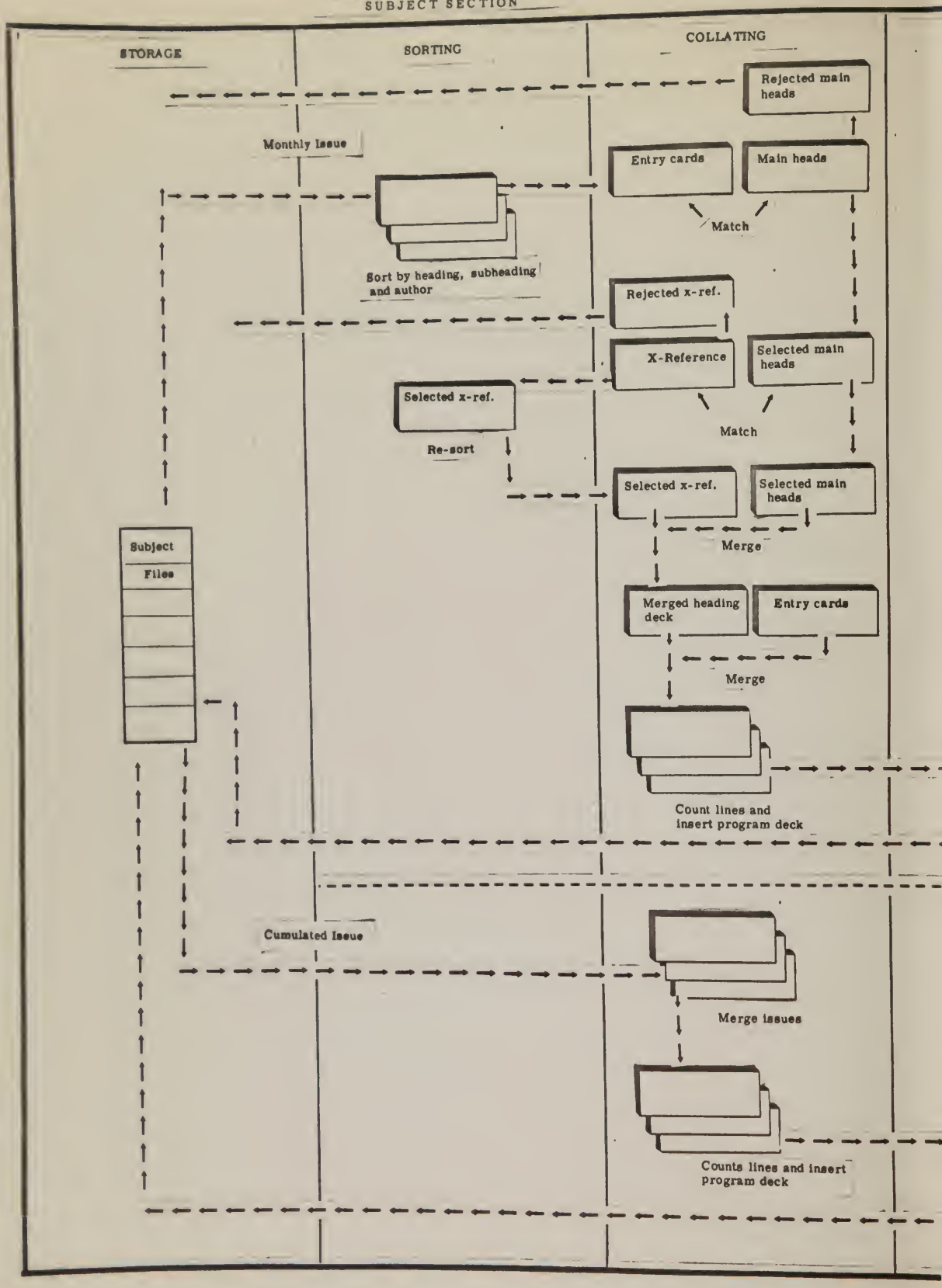
APPENDIX 5-B

PREPARATION FOR CAMERA: AUTHOR SECTION



APPENDIX 5-C

PREPARATION FOR CAMERA:
SUBJECT SECTION



APPENDIX 5-C

PREPARATION FOR CAMERA:
SUBJECT SECTION